Terrestrial analogues for extraterrestrial life

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The past decade has seen the discovery of planetary companions to ~120 stellar neighbours. Those planets are subject to a wide range of environments, from hot Jupiters at ambient temperatures >1400K to gas giants in Jupiter-like orbits at $T_{amb} \sim 150$ K. A key issue facing astrobiology is assessing what subset of those environments might be hospitable to life; in particular, since cold environments are much more common than hot, what are the low-temperature limits for species growth and survival?

We have been conducting experiments designed to test the cold limits for growth of four extremophile species: two methanogens, *Methanosarcina acetivorans*, a mesophile, and *Methanococcoides burtonii*, an Antarctic psychrotroph; and two extremely halophilic archaea, *Halobacterium* sp. NRC-1, a mesophile, and *Halorubrum lacusprofundi*, an Antarctic psychrotroph. Both types of species are potentially relevant to life in Martian environments: methanogens are one of the proposed sources of significant methane in the present-day Martian atmosphere, while halophiles could take advantage of sub-surface brine, which remains liquid at temperatures well below 270K. Initial results show growth of the psychotrophic archaea at sub-zero temperatures. Both types of organisms feature an apparent morphological response to cold environments.